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## GIS Technology: A Valuable Tool for Local Health Departments and Public Health Programs

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### Introduction

In recent years, many of Indiana's local health departments (LHD) have incorporated GIS into their existing public health programs. What once was marked on a paperboard map with pushpins has been replaced with detailed information stored in databases, mapping software, and aerial photographs. For those of you who may not be familiar with GIS or GPS units, they are simply defined as:

*GIS* - Geographic Information System - a collection of computer hardware, software, and geographic data used to store, view, manage, and analyze all forms of geographic information, especially maps.

*GPS* - Global Positioning System - a system of satellites, computers, and receivers able to determine the latitude and longitude of a receiver on earth by calculating the time difference for signals from different satellites to reach the receiver.

Mapping techniques, variations in GPS receivers, and software can be tailored to fit the individual needs of any program. LHDs in rural areas may not have an immediate need for a GIS program, while larger, more urban LHDs may have several advanced mapping units and staff specifically responsible for a GIS program. The program being developed in Tippecanoe County lies somewhat in the middle of these two extremes. While we have the luxury of GIS staff at the county level for assistance, Health Department personnel have developed a GIS program to fit our specific needs. The following is an overview of how the Tippecanoe County Health Department (TCHD) saw a need and implemented GIS to enhance our existing environmental programs.

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## **Getting to Know GIS**

In 2003, Tippecanoe County and the City of Lafayette launched a GIS Web site which included parcel information and many useful layers such as floodplain boundaries, soil descriptions, topography, and catch basins, to name a few. Although no TCHD staff had any prior training or experience with GIS, they quickly gained hands-on experience from accessing the Tippecanoe County Web site and using the layers and tools available. Staff within the TCHD environmental division realized an immediate use for mapping of on-site sewage systems, mosquito surveillance, and water sampling locations. Fortunately, we had a wealth of knowledge within the information technology department at the county level and very helpful GIS personnel to assist when necessary. After several brainstorming and tutorial sessions, we were on our way!

In 2004, the Indiana State Department of Health (ISDH) received grant dollars from the Centers for Disease Control and Prevention (CDC) to purchase GPS handheld units (Garmin Etrex Legend, valued at \$170 apiece) for each county in Indiana that requested a unit. We quickly jumped at the opportunity to incorporate a field unit to complement the existing mapping capabilities from the county Web site. The Garmin Etrex Legend is a “basic” handheld unit capable of multiple data sets and vague mapping. Although there are more advanced mapping and surveying units capable of managing datasets and detailed mapping, the Garmin Etrex Legend fit the scope of our program.

## **Firsthand Experience**

During 2004, TCHD environmental staff began using the handheld units for marking locations in the field during routine inspections. Although the units seemed intimidating and clumsy at first, staff quickly became familiar with the setup and features available. One important feature that any handheld unit should have when marking a location is *Wide Area Augmentation System* (WAAS). WAAS allows the user to have a much more precisely marked location, which, in turn, will help to retrieve the location in the future.

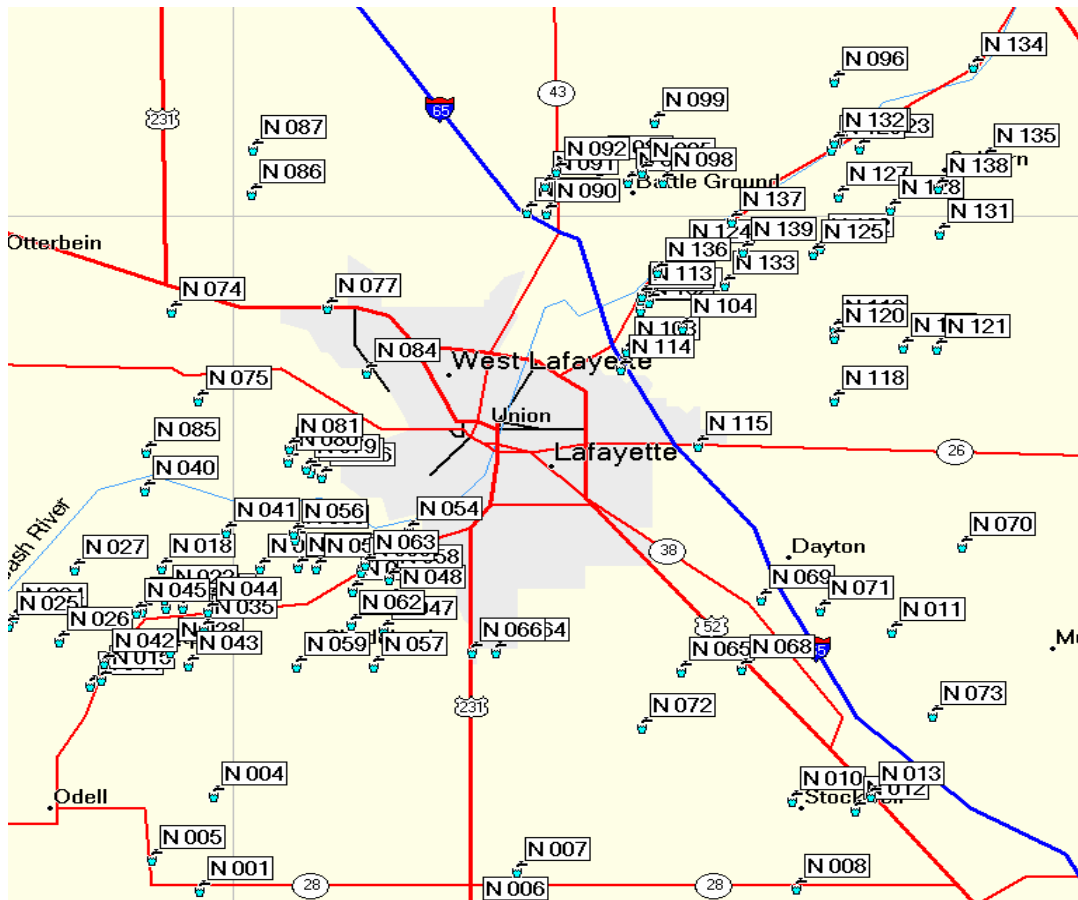
Interest began to grow within the department pertaining to GIS, its uses, and benefits. Two additional Garmin Etrex Legend units were purchased for staff and interns to use when conducting field work. What started with single handheld units marking septic systems quickly grew into a large database and mapping program for all permitted residential sewage systems, all mosquito-related activities, and surface and groundwater monitoring locations.

Handheld units are used to mark and locate septic tanks, distribution boxes, and perimeter drain outlets. Each year, saved locations can easily be downloaded to a personal computer and incorporated to the county GIS Web site with detailed information available to staff and the public. Features available on the county GIS Web site allow staff to view layers such as soil characteristics, topography, and floodplain information when planning and determining feasibility for on-site sewage systems. Mapping techniques have also been used with great success in local watershed management plans. Areas of a watershed with dwellings that have no records of sewage systems were highlighted and targeted to educate those individuals about the importance of proper sewage disposal.

The two environmental programs significantly enhanced by GIS are the mosquito and water sampling programs. With very limited staff and resources, GIS has helped us to identify and target areas known to have mosquito-breeding problems. By using floodplain data and tracking precipitation amounts, maps can be generated that direct staff in response to various rainfall amounts to particular areas that hold water following rain events. In addition, adult mosquito trapping locations and locations of dead birds provide evidence of West Nile virus activity that

can be mapped to identify clusters of elevated virus activity. This aids in the effort to warn the public of the potential for human infection and the need for personal protection strategies.

During 2005, handheld units were used during a county-wide groundwater sampling program. Well locations were mapped along with results from the nitrate tests being conducted. By overlaying soil maps along with testing location and results, clusters of elevated nitrate levels were obviously recognized in areas of sandy-based soil coupled with shallow well depths. Although soils information is not described in the illustration, a trend of elevated samples can be followed along the stem of the Wabash River where there are primarily sandy-based soils.



Each recreational season, public access sites along local waterways are tested for bacteria levels. Should any location exceed bathing beach standards, signs are posted to warn patrons of elevated levels of bacteria. Beginning in 2007, the public can access the county GIS Web site to learn testing dates and test results on an interactive map as illustrated below.



### Looking to the Future

Interest within the TCHD continues to grow and new uses for GIS will soon become commonplace not only in the environmental division but also in the foods and swimming pool inspection programs. Soon, staff members from both programs hope to have inspection reports available on the county GIS Web site along with a link to the Visitors Bureau to aid patrons in making informed decisions and to facilitate establishment owners striving for excellence.

Establishing a GIS program, or simply becoming familiar with GPS units and mapping software, can be a daunting and intimidating task. There certainly will be obstacles with cost, technology, or personnel, but the development and enhancement to public health programs far outweigh the initial hurdles. Not all GIS programs require elaborate software or units. For example, the TCHD began with a single donated handheld unit, helpful information technology staff, and a willingness to be open to change and possibility. Recent budgets for the environmental division have been a meager \$2,500 for supplies, which translates into utilizing available resources on the Web and within the county. If you are interested but do not know where to begin, contact ISDH representatives who can provide information on several counties in Indiana that have established GIS programs and would be happy to assist in your efforts. Training opportunities and Internet Web sites offering free downloads of data and aerial photography include:

<http://www.indiana.edu/~gisdata/>  
<http://www.earth.google.com>  
<http://esri.com>

For more information on GIS technologies and services, contact Ed Lutz, ISDH GIS Program Supervisor, at 317.233.7695 or [glutz@isdh.in.gov](mailto:glutz@isdh.in.gov).



# Interpretation of Hepatitis C Lab Reports

Michael Wilkinson, BS  
Hepatitis C Epidemiologist

The U.S. Food and Drug Administration (FDA) first licensed tests to detect antibody to hepatitis C virus (anti-HCV) in 1990. Since that time, new versions of these and other FDA-approved anti-HCV tests have been used widely for clinical diagnosis and screening of asymptomatic persons. This article will describe some of these commonly used tests and methods of interpreting results.

## Serology

Serologic testing for the presence of HCV antibody (anti-HCV) is recommended for initially identifying or screening persons with hepatitis C since serologic screening is less expensive than other tests. However, serologic testing cannot determine acute, chronic, or resolved infection, only that the patient has been exposed to HCV. Enzyme linked immunosorbent assay (ELISA or EIA) is one of the more commonly used initial screening tests. Positive EIA tests are then confirmed using polymerase chain reaction (PCR) or recombinant immune assay (RIBA) testing. RIBA is most often used to ensure the initial antibody test was not a false positive. PCR testing is the most sensitive detection test for determining active infection (see Table 1).

According to the Centers for Disease Control and Prevention (CDC), a person is considered to have serologic evidence of HCV infection if a RIBA or PCR test is positive for HCV. However, many laboratories report a positive result based on a positive screening test result only and do not verify these results with more specific serologic or nucleic acid testing unless ordered by the requesting physician. Reasons include the lack of an established laboratory standard for confirmatory testing, lack of understanding regarding the performance and interpretation of the screening and supplemental HCV tests, and the high cost of the supplemental HCV tests.

Unfortunately, understanding the interpretation of anti-HCV screening test results, knowing when more specific testing should be performed, and understanding which tests should be used for confirmation can be confusing. Recently, the CDC issued recommendations for using signal-to-cutoff ratios (s/co) in lieu of supplemental testing. The use of s/co ratios minimizes the amount of supplemental testing needed, while improving the reliability of reported test results and reducing costs of supplemental testing (MMWR, February 7, 2003, Vol. 52, <http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5203a1.htm>). A specific s/co ratio can be identified for each test that would predict a true antibody-positive result (as defined by the results of supplemental testing)  $\geq 95\%$  of the time, regardless of the anti-HCV prevalence or characteristics of the population being tested. Most laboratory tests use 3.8 as the reference value most often used with the signal to cut-off ratio test.

For more information on serologic testing, please visit the CDC Web site at <http://www.cdc.gov/ncidod/diseases/hepatitis/serology/index.htm>

## Viral Load Testing

Viral loads are confirmatory blood tests that measure the amount of HCV ribonucleic acid (RNA) in the blood and confirm whether an individual is actively infected with HCV. There are two categories of viral load tests—qualitative and quantitative. The presence of viral RNA indicates that the virus is actively replicating (reproducing and infecting new cells). Usually, a viral load

test is done after a person has tested positive for exposure to HCV based on an initial antibody test.

**Qualitative viral load tests** – These tests determine the overall presence of HCV RNA in the blood. This type of test is usually used to confirm chronic HCV infection. If viral RNA is detected, a positive result is reported; if viral RNA is not detected, the test result is negative.

**Quantitative viral load tests** – These tests measure the amount of virus in one milliliter of blood. They are often used to assess whether or not treatment with interferon or interferon plus ribavirin is likely to be successful and, later, if treatment is working.

Viral load test results were previously measured in number of copies but are now typically reported in terms of international units per milliliter (IU/mL). However, more than one PCR test may need to be performed, since low-level viremia may be present and not detected by the test. Viremia can fluctuate for no apparent reason; therefore, it is possible to have a negative PCR test (when viral load is below the threshold value) and the person can actually be positive for HCV (<http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5203a1.htm>).

**Interpreting viral load test results** – HCV viral load is often reported as low or high with the value expressed as the number of RNA copies per milliliter of blood or as international units (IU) per milliliter (ml) of blood. The reference range depends on the exact test being used, but in general, the reference ranges are:

- Low – less than 2 million copies/ml or less than 800,000 IU/ml
- High – more than 2 million copies/ml or more than 800,000 IU/ml

Changes in viral load are sometimes expressed in terms of logs. A log change is a 10-fold increase or decrease. An easy way to determine a log drop in viral load is to decrease the value by one zero. For instance, a one-log drop in a viral load of 1,000,000 international units is 100,000 international units; a two-log drop in a viral load of 1,000,000 international units is 10,000 international units. (Hepatitis C Support Project, VERSION 2.1, November 2006; Alan Franciscus, November 2006)

### **Liver Function Tests (LFT)**

LFTs are the most common tests to determine liver problems. These tests measure the level of chemicals detected in the blood that are produced when the liver is not functioning properly. Other LFTs may indicate when the liver is inflamed and not functioning properly. Bilirubin (responsible for jaundice color) increases and albumin decreases.

**Alanine aminotransferase (ALT or SGPT)** – ALT/SGPT levels vary by age and laboratory testing, but normal range is generally between 7-56 units/liter (u/l). This is a protein, specifically an enzyme, that leaks out of liver cells when liver cells are damaged. An increase in ALT above normal range can mean ongoing liver damage, although the damage may not be the result of HCV. Patients with chronic hepatitis C may have ALT levels that fluctuate between 20-40 points between blood tests. In some patients with HCV, ALT levels can remain normal. It is important that ALT tests be repeated over time to get best indications of the level of liver damage. ALT is probably the best test to indicate liver damage.

**Aspartate aminotransferase (AST or SGOT)** – AST/SGOT levels vary by age and laboratory testing, but normal range is generally between 5-35 u/L. This is an enzyme produced by liver

cells and is similar to ALT. AST is also produced in muscle, heart, kidney, and brain tissue. Often, ALT and AST will be elevated at the same time.

### **Case Definitions**

No HCV test can distinguish acute and chronic hepatitis C infection. This is why it is critical to know the case definitions of acute and chronic hepatitis C. The case definition includes laboratory and ALT markers, so understanding these is important. To be classified as acute, a case must meet three distinct criteria: 1.) Discrete onset of hepatitis symptoms; 2.) ALT levels that are at least 7 times the upper limit of the reference range; 3.) Test positive for HCV antibody and negative for hepatitis A and hepatitis B. If a case meets all three of these characteristics, the case is classified as acute. If a case tests positive for HCV antibody and does not meet the other criteria, the case is considered chronic.

#### Acute Hepatitis C Case Definition

- Discrete onset of symptoms: dark urine, pale stool, fatigue, jaundice
- ALT must be 7 times upper limit of reference range
- HCV antibody positive
  - HCV antibody positive by EIA with signal to cut-off ratio  $\geq$  to 3.8 OR
  - Anti-HCV by RIBA alone is confirmatory OR
  - HCV RNA positive
- Patient must also be hepatitis A and hepatitis B negative

>80% of acute hepatitis C cases will become chronic and not clear the virus within 6 months.

#### Chronic Hepatitis C Case Definition

- HCV positive 6 months or longer:
  - HCV antibody positive by EIA with signal to cut-off ratio  $\geq$  to 3.8 OR
  - Anti-HCV by RIBA alone is confirmatory OR
  - HCV RNA positive

>most are asymptomatic

>liver enzymes may be normal

>antibody and perhaps RNA will be positive

**Table 1. CDC Recommendations for reporting results of testing for antibody to hepatitis C virus (anti-HCV) by type of reflex supplemental testing performed**

Anti-HCV screening test results	Supplemental test results	Interpretation	Comments
Screening-test-negative*	Not applicable	Anti-HCV-negative	Not infected with HCV, unless recent infection is suspected or other evidence exists to indicate HCV infection
Screening-test-positive* with high signal-to-cut-off (s/co) ratio	Not done	Anti-HCV-positive	Probably indicates past or present HCV infection; supplemental serologic testing not performed. Samples with high s/co ratios usually (>95%) confirm positive, but <5 of every 100 might represent false-positives; more specific testing can be requested, if indicated
Screening-test-positive	Recombinant immunoblot assay (RIBA®)-positive	Anti-HCV-positive	Indicates past or present HCV infection
Screening-test-positive	RIBA-negative	Anti-HCV-negative	Not infected with HCV, unless recent infection is suspected or other evidence exists to indicate HCV infection
Screening-test-positive	RIBA-indeterminate	Anti-HCV-indeterminate	HCV antibody and infection status cannot be determined; another sample should be collected for repeat anti-HCV testing (>1 month) or for HCV RNA testing
Screening-test-positive	Nucleic acid test (NAT)-positive	Anti-HCV-positive, HCV RNA-positive	Indicates active HCV infection
Screening-test-positive	NAT-negative, RIBA-positive	Anti-HCV-positive, HCV RNA-negative	The presence of anti-HCV indicates past or present HCV infection; a single negative HCV RNA result does not rule out active infection
Screening-test-positive	NAT-negative, RIBA-negative	Anti-HCV-negative, HCV RNA-negative	Not infected with HCV
Screening-test-positive	NAT-negative, RIBA-indeterminate	Anti-HCV-indeterminate, HCV RNA-negative	Screening test anti-HCV result probably a false-positive, which indicates no HCV infection

\* Screening immunoassay test results interpreted as negative or positive on the basis of criteria provided by the manufacturer.

Source: <http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5203a1.htm>

## **TB Control 2007:** *Meet the New Kids on the Block*

Tina Feaster, BS  
TB Epidemiologist

The Indiana State Department of Health (ISDH) Tuberculosis (TB) Control Program has a new look. The program added three new positions in 2006, including two Regional Nurses and a TB Epidemiologist. The program also has a new Program Director and Public Health Advisor.

In January 2007, **Sarah Burkholder** assumed her role as the new TB Control Program Director. Sarah has approximately 15 years of TB experience, with 6 years in South America and almost 8 years in Elkhart County. Her responsibilities include overseeing TB cases, writing grants and policies, and assisting the TB Regional Nurses and Outreach Workers.

**Shameer Poonja**, who came to the ISDH in March of 2006, is a Public Health Advisor with the Centers for Disease Control and Prevention (CDC). Shameer's previous seven years of TB experience comes from working with New York City's homeless population and the refugee



program in Boston. His duties at the ISDH include overseeing Marion County's TB cases, education and training, grants and policies, and refugee and immigration B1/B2 arrivals.

**Tina Feaster** started as the TB Epidemiologist in September of 2006. This position is new to the program. Although part of the ISDH Epidemiology Resource Center, the position is embedded in the TB Control Program. Tina has 13 years of experience working as a microbiologist in the ISDH Mycobacteriology (TB) lab. Her duties include contact investigations and follow-up, surveillance, analysis of genotyping information, and outbreak investigations.

Before 2006, the TB Control Program included two contractual Regional Nurse Consultants, **Joy Hardacre** and **Barbara Weber-White**. Two additional Regional Nurse Consultants were hired in 2006 to provide additional coverage throughout Indiana. The Regional Nurse provides education and training to the local health departments along with guidance on case management, contact investigation, and site visits for active TB cases. Joy has been a TB Regional Nurse for nine years and has an additional five years experience as a TB Outreach Worker. Barb has eight years experience as a TB Regional Nurse and one year as an Outreach Worker. In May 2006, **Linda Ramirez** came aboard as a Regional Nurse. Linda had been an Outreach Worker in Lake County for the previous year. **Donna Ewing** came aboard as a Regional Nurse in July 2006. Donna has 21 years of experience as a Licensed Practical Nurse.

**Lori Mathews** has served as the TB Administrative Assistant for the past three years. Lori plays a critical role in coordinating all the correspondence received from the daily activities of the TB Control Program. Through her comprehensive organizational skills, she enters data, relays information on new cases, and orders TB meds.

The TB Control Program includes several other team members: Two Medical Advisors, **Dr Richard Kohler** and **Dr Erica Leazenby**, conduct monthly case reviews. The ISDH also contracts eight TB Outreach Workers: **Sandy Miller, Kay Wilcox, Patricia Gray, Renee Cotterman, Deb Moon, Jean Glover, Mike Exom, and Anitra Mitchell**. TB Outreach Workers help with contact investigations, trainings, and, especially, Directly Observed Therapy (DOT) of TB medications.



## **INDIANA STATE DEPARTMENT OF HEALTH IMMUNIZATION PROGRAM PRESENTS:**

### *Immunizations from A to Z*

Immunization Health Educators offer this FREE, one-day educational course that includes:

- Principles of Vaccination
- Childhood and Adolescent Vaccine-Preventable Diseases
- Adult Immunizations
  - Pandemic Influenza
- General Recommendations on Immunization
  - Timing and Spacing
  - Indiana Immunization Requirements
  - Administration Recommendations
  - Contraindications and Precautions to Vaccination
- Safe and Effective Vaccine Administration
- Vaccine Storage and Handling
- Vaccine Misconceptions
- Reliable Resources

This course is designed for all immunization providers and staff. Training manual, materials, and certificate of attendance are provided to all attendees. Please see the Training Calendar for presentations throughout Indiana. Registration is required. To attend, schedule/host a course in your area, or for more information, please reference

<http://www.IN.gov/isdh/programs/immunization.htm>.

# ISDH Data Reports Available

**The ISDH Epidemiology Resource Center has the following data reports and the Indiana Epidemiology Newsletter available on the ISDH Web Page:**

[http://www.IN.gov/isdh/dataandstats/data\\_and\\_statistics.htm](http://www.IN.gov/isdh/dataandstats/data_and_statistics.htm)

HIV/STD Quarterly Reports (1998-June 06)	Indiana Mortality Report (1999, 2000, 2001, 2002, 2003, 2004, 2005)
Indiana Cancer Incidence Report (1990, 95, 96, 97, 98)	Indiana Infant Mortality Report (1999, 2002, 2003, 2004)
Indiana Cancer Mortality Report (1990-94, 1992-96)	Indiana Natality Report (1998, 99, 2000, 2001, 2002, 2003, 2004)
Combined Cancer Mortality and Incidence in Indiana Report (1999, 2000, 2001, 2002, 2003)	Indiana Induced Termination of Pregnancy Report (1998, 99, 2000, 2001, 2002, 2003, 2004, 2005)
Indiana Health Behavior Risk Factors (1999, 2000, 2001, 2002, 2003, 2004, 2005)	Indiana Marriage Report (1995, 97, 98, 99, 2000, 2001, 2002)
Indiana Health Behavior Risk Factors (BRFSS) Newsletter (9/2003, 10/2003, 6/2004, 9/2004, 4/2005, 7/2005, 12/2005, 1/2006, 8/2006, 10/2006)	Indiana Infectious Disease Report (1997, 98, 99, 2000, 2001, 2002, 2003, 2004, 2005)
Indiana Hospital Consumer Guide (1996)	Indiana Maternal & Child Health Outcomes & Performance Measures (1990-99, 1991-2000, 1992-2001, 1993-2002, 1994-2003)
Public Hospital Discharge Data (1999, 2000, 2001, 2002, 2003, 2004, 2005)	

## HIV Disease Summary

**Information as of April 30, 2007 (based on 2000 population of 6,080,485)**

### *HIV - without AIDS to date:*

381	New HIV cases from April 2006 thru April 30, 2007	12-month incidence	6.62 cases/100,000
3,721	Total HIV-positive, alive and without AIDS on April 30, 2007	Point prevalence	64.69 cases/100,000

### *AIDS cases to date:*

334	New AIDS cases from April 2006 thru April 30, 2007	12-month incidence	5.81 cases/100,000
3,991	Total AIDS cases, alive on April 30, 2007	Point prevalence	69.38 cases/100,000
8,247	Total AIDS cases, cumulative (alive and dead)		

## REPORTED CASES of selected notifiable diseases

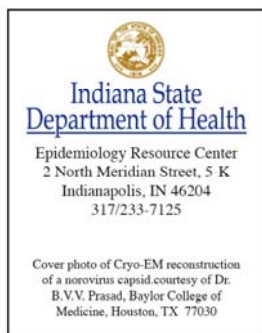
Disease	Cases Reported in April MMWR Weeks 14-18		Cumulative Cases Reported January – April MMWR Weeks 1-18	
	2006	2007	2006	2007
Campylobacteriosis	35	31	106	102
Chlamydia	2,006	1,521	7,215	6,872
Cryptosporiosis	3	5	12	15
Cyclosporiasis	1	0	1	1
<i>E. coli</i> O157:H7	1	7	11	9
Haemophilus influenzae	10	9	22	17
Hepatitis A	3	1	7	5
Hepatitis B	5	8	10	13
Hepatitis C	1	0	1	0
Gonorrhea	829	659	3,120	2,794
Legionellosis	0	1	3	5
Listeriosis	1	2	4	4
Lyme Disease	1	0	2	1
Measles	0	0	1	0
Meningococcal, invasive	0	7	9	14
Mumps	3	0	3	0
Pertussis	13	8	57	11
Rocky Mountain Spotted Fever	1	1	1	1
Salmonellosis	45	59	144	169
Shigellosis	12	8	42	22
Streptococcus pneumoniae (invasive, all ages)	72	87	255	236
Streptococcus pneumoniae (invasive, drug resistant)	19	28	68	64
Streptococcus pneumoniae (invasive, <5 years of age)	5	3	26	13
Syphilis (Primary and Secondary)	4	0	26	14

**REPORTED CASES** of selected notifiable diseases (cont.)

Disease	Cases Reported in April MMWR Weeks 14-18		Cumulative Cases Reported January – April MMWR Weeks 1-18	
	2006	2007	2006	2007
Tuberculosis	11	8	40	46
Yersiniosis	0	2	1	4
Animal Rabies	1 (bat)	1 (bat)	1 (bat)	1 (bat)

**For information on reporting of communicable diseases in Indiana, call the  
*Epidemiology Resource Center* at (317) 233-7125.**





The *Indiana Epidemiology Newsletter* is published monthly by the Indiana State Department of Health to provide epidemiologic information to Indiana health care professionals, public health officials, and communities.

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